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April 7, 2022

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

CATAWBA NUCLEAR STATION, UNIT NOS. 1 AND 2
DOCKET NOS. 50-413, 50-414 / RENEWED LICENSE NOS. NPF-35 AND NPF-52

MCGUIRE NUCLEAR STATION, UNIT NOS. 1 AND 2
DOCKET NOS. 50-369, 50-370 / RENEWED LICENSE NOS. NPF-9 AND NPF-17

SUBJECT: Response to Request for Additional Information (RAI) Regarding Revision 1 of DPC-NE-1007-P, "Conditional Exemption of the EOC MTC Measurement Methodology"

REFERENCES:

1. Duke Energy letter, *Revision 1 of DPC-NE-1007-P, "Conditional Exemption of the EOC MTC Measurement Methodology,"* dated October 25, 2021 (ADAMS Accession No. ML21298A133)
2. NRC letter, *Catawba Nuclear Station, Units 1 and 2 and McGuire Nuclear Station, Units 1 and 2 - Request for Additional Information Regarding License Amendment Request for Revision to the Conditional Exemption of the End of Cycle Moderator Temperature Coefficient Measurement Methodology (EPID L-2021-LLA-0198)*, dated March 9, 2022 (ADAMS Accession No. ML22063B178)

Ladies and Gentlemen:

In Reference 1, Duke Energy Carolinas, LLC (Duke Energy) submitted a License Amendment Request (LAR) for the Renewed Facility Operating Licenses (FOLs) for Catawba Nuclear Station Units 1 and 2 (CNS) and McGuire Nuclear Station Units 1 and 2 (MNS) related to the end-of-cycle (EOC) rated thermal power (RTP) moderator temperature coefficient (MTC) measurement. Specifically, Duke Energy requested NRC review and approval of proposed changes to DPC-NE-1007-P, "Conditional Exemption of the EOC MTC Measurement

Methodology." In Reference 2, the Nuclear Regulatory Commission (NRC) staff requested additional information regarding Reference 1.

Enclosure 1 provides Duke Energy's response to the Reference 2 RAI. As described in Enclosure 1, an updated version of Change 2-1 of the Reference 1 LAR is provided in Attachment 1. This updated Change 2-1 supersedes Change 2-1 of the Reference 1 LAR. Enclosure 1 and Attachment 1 include information that is proprietary to Duke Energy. In accordance with 10 CFR 2.390, Duke Energy requests that Enclosure 1 and Attachment 1 be withheld from public disclosure. An Affidavit is included (Attachment 3) attesting to the proprietary nature of the information. A non-proprietary version of Enclosure 1 and Attachment 1 is included in Enclosure 2 and Attachment 2, respectively. The conclusions of the No Significant Hazards Consideration and Environmental Consideration in the original license amendment request are unaffected by this RAI response.

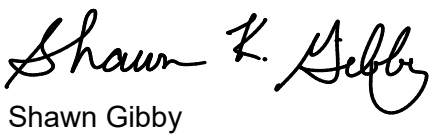
This submittal contains no new regulatory commitments.

Duke Energy is notifying the states of North Carolina and South Carolina by transmitting a copy of this letter to the designated state officials. Should you have any questions concerning this letter, or require additional information, please contact Lee Grzeck, Manager (acting) – Nuclear Fleet Licensing, at 980-373-1530.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on April 7, 2022.

Sincerely,



Shawn Gibby
Vice President – Nuclear Engineering

Enclosures:
1. Response to Request for Additional Information (Proprietary)
2. Response to Request for Additional Information (Redacted)

Attachments:
1. Updated Change 2-1 (Proprietary)
2. Updated Change 2-1 (Redacted)
3. Affidavit of Shawn Gibby

cc: (all with Enclosures/Attachments unless otherwise noted)

L. Dudes, Regional Administrator USNRC Region II
J. D. Austin, USNRC Senior Resident Inspector – CNS
G. A. Hutto, USNRC Senior Resident Inspector – MNS
Z. Stone, NRR Project Manager – CNS
J. Klos, NRR Project Manager – MNS

D. P. Crowley, Interim Section Chief, NC DHSR (Without Enclosure 1 and Attachment 1)
L. Garner, Manager, Radioactive and Infectious Waste Management Section (SC)
(Without Enclosure 1 and Attachment 1)
A. Nair, Director, Environmental Response (SC) (without Enclosure 1 and Attachment 1)

Enclosure 1

Response to Request for Additional Information (Proprietary)

Note: Text that is within brackets with a superscript or double brackets is proprietary to Duke Energy.

Enclosure 2

Response to Request for Additional Information (Redacted)

Note: Text that is within brackets with a superscript or double brackets is proprietary to Duke Energy and has been removed.

Background for RAI-01, RAI-02 and RAI-03

The Safety Analysis (SA) MTC calculation, as described in the licensee's technical justification change 2-1 of DPC-NE-1007-P, Rev. 1, (ADAMS Accession No. ML21298A133, (ML21298A134 - non-public)), is the following:

The SA MTC is calculated by considering its mean and standard deviation separately. The mean of SA MTC is represented by equation (1).

$$\mu_{SA\ MTC} = \sum_{i=1}^{N} \mu_i \qquad (1)$$

Where each μ_i represents the mean (or bias) of a different parameter which impacts the SA MTC. Thus, the total mean of SA MTC is the summation of these individual means. The standard deviation of SA MTC is represented by equation (2).

$$\sigma_{SA\ MTC} = \sqrt{\sum_{i=1}^{M} \sigma_i^2} \qquad (2)$$

The SA MTC is calculated by combining the mean and the variance as given in equation (3).

$$SA\ MTC = \mu_{SA\ MTC} \pm k \cdot \sigma_{SA\ MTC} \qquad (3)$$

NRC RAI-01

Please provide a description of each term (i.e., each μ_i) in equation (1) above. Please describe what source of uncertainty is represented by the term and provide justification of the value chosen. Please confirm that the set of terms considered is the complete set of terms which could bias the SA MTC.

NRC RAI-02

Please provide a description of each term (i.e., each σ_i) in equation (2) above. Please describe what source of uncertainty is represented by the term and provide justification of the value chosen. Please confirm that the set of terms considered is the complete set of terms which could impact the variance of the SA MTC and provide justification that each term can be treated independently of the others.

NRC RAI-03

Please provide the value of the multiplier (i.e., the k term) in equation (3) above, and please justify the choice of this value.

Response to RAI-01, RAI-02 and RAI-03

A single response is provided for RAI-01, RAI-02 and RAI-03.

The Technical Specification (TS) LCO limit is established to ensure the MTC value assumed in the evaluation of UFSAR Chapter 15 accident and transient analyses is not exceeded. The difference between the most negative analysis limit assumed in the safety analysis and the TS LCO MTC limit is the result of differences between the initial condition assumptions made in the evaluation of UFSAR Chapter 15 accidents relative to the conditions associated with the TS LCO. The TS LCO limit corresponds to the EOC rated thermal power (RTP), all rods out (ARO) equilibrium condition.

Selection of Key Parameters

The MTC is sensitive to changes in temperature, reactor coolant density, and neutron spectrum. If soluble boron is present in the coolant, a decrease in coolant density would produce a positive reactivity effect from the change in poison density. However, because the TS LCO MTC limit is defined at 0 ppmb, soluble boron is not considered a key parameter. **[**

][a,c]

Based on the above discussion, a complete set of parameters which influence the MTC were selected. They include **[** **]**[a,c]

SA MTC Calculation

The Safety Analysis MTC is calculated by **[**

][a,c] Equation 1 also employs updated nomenclature to be consistent with that used by the NRC in the background discussion for RAI-01, RAI-02 and RAI-03. Revised proprietary and non-proprietary Section 2.2 change pages are provided in Attachments 1 and 2, respectively.

$$\left(\right)^{a,c} \qquad \text{(eq. 1)}$$

Table 1 defines each term in equation 1.

The MTC allowances resulting from changes in **[** **]**[a,c] are calculated using equations 2 through 7. Each term represents the change in MTC relative to the reference conditions associated with the TS MTC LCO limit (equilibrium, RTP, ARO, 0 ppmb). The method used to calculate the change in MTC produced from a change in each parameter is unchanged between the **[** **]**[a,c]

Table 2 defines the terms in equations 2 through 7 along with the basis for each term.

[ ]a,c (eq. 2)

[ ]a,c (eq. 3)

[ ]a,c (eq. 4)

[ ]a,c (eq. 5)

[ ]a,c (eq. 6)

[ ]a,c (eq. 7)

[**]**[a,c]

Sensitivity studies were performed with multiple reload cores to identify the MTC behavior resulting from changes in **[**]a,c For each reload core, a reference MTC calculation was performed at the conditions of the TS MTC LCO followed by MTC calculations where each variable was perturbed over a range of conditions which bound potential values for each variable. Results from these studies were used to identify the behavior in the MTC relative to the parameter being changed and to **[**]a,c

[

]a,c

[ ]a,c

[

]a,c

[

]a,c

[

]a,c

[ ]a,c

[

]a,c

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]a,c

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]a,c

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]a,c

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]a,c

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]a,c

Summary

[

]a,c It is therefore with high confidence that the SA MTC will fall within the 95% confidence interval when "k" in the generalized form of equation 1 shown below (equation 3 in the background section of the RAI) is set to a value of [ ]a,c

$$SA\ MTC = \mu_{SA\ MTC} + k \cdot \sigma_{SA\ MTC}$$

Table 1
Equation 1 Term Definitions

Parameter	Definition
SA MTC	Most negative MTC assumed in the analysis of UFSAR Chapter 15 accidents.
$MTC_{TS\ LCO}$	TS 3.1.3 limiting condition of operation MTC value.
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c

Table 2
Equations 2 Through 7 Term Definitions

Parameter	Definition
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	]a,c

Table 2 cont'd
Equations 2 Through 7 Term Definitions

Parameter	Definition
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c
[ ]a,c	[ ]a,c

Figure RAI-3-1

a,c

Figure RAI-3-2

a,c

NRC RAI-04

In the **[[**

]] Other mechanisms of introducing a quadrant power tilt may not produce similar compensating effects within each quadrant. It is unclear whether effects between quadrants will "average out" for larger tilts. Please discuss other plausible mechanisms of introducing incore tilt, and whether these might have a greater impact on the MTC and require the inclusion of an incore flux tilt criterion.

Response

In the analytical example presented for Change 3-1, **[**

][a,c]

Other mechanisms which may introduce a quadrant power tilt other than **[** **]**[a,c] include inadequate randomization of re-insert fuel from a previous cycle of operation where a reactivity driver from an inlet flow or inlet temperature asymmetry was present, or from a manufacturing issue or error that impacts fuel or burnable absorber reactivity. For a quadrant power tilt to occur from a manufacturing issue or error the following conditions must occur simultaneously. The manufacturing issue or error must result in an important fuel or burnable poison design parameter (i.e. enrichment, density, etc.) being consistently biased in one direction relative to the design specification, the off-spec condition must occur in only a limited number of the fuel assemblies or burnable absorbers, and the randomization process must fail to evenly distribute fuel randomly throughout the core such that the off-spec fuel assemblies or burnable absorbers are located in the same quadrant. While this scenario is highly improbable, **[**

][a,c]

[

][a,c]

[

]a,c

Figure RAI-4-1

[a,c

]

NRC Request for Confirmation of Information, RCI-01

The proposed revision to Note 1 of Table 3-2 in DPC-NE-1007-P, Rev. 1, states that the assembly power distribution criterion is not considered failed unless **[[**

]] exceed the ±10 percent limit.
Please confirm that in the latter case, the criterion would be considered failed if the limit is exceeded in different core locations in each power distribution measurement.

Response

Yes, the criterion would be considered failed if the limit is exceeded in different core locations in each power distribution measurement.

Attachment 1

Updated Change 2-1 (Proprietary)

Note: Text that is within brackets with a superscript is proprietary to Duke Energy.

Attachment 2

Updated Change 2-1 (Redacted)

Note: Text that is within brackets with a superscript is proprietary to Duke Energy and has been removed.

Change 2-1: Relationship Between The Technical Specification LCO limit and The Most Negative MTC (Section 2.2)

Description of Change: Change "affect" to "effects" in the last sentence of Section 2.2, paragraph 2. Add an alternative approach for calculating the most negative MTC used in UFSAR Chapter 15 transient and accident analyses

2.2 Relationship Between The Technical Specification LCO Limit and The Most Negative MTC

The Technical Specification LCO limit is established to ensure that the MTC value assumed in the evaluation of UFSAR Chapter 15 accident and transient analyses is not exceeded. The difference between the most negative analysis limit assumed in the safety analysis and the TS LCO MTC limit is the result of differences in the initial condition assumptions made in the evaluation of UFSAR Chapter 15 accidents relative to the conditions associated with the Technical Specification LCO limit. The Technical Specification LCO limit corresponds to EOC rated thermal power (RTP) ARO equilibrium conditions.

[

] [a,c]

[

] [a,c]

Technical Justification:

The first change removes excessive conservatism in the method **[**

] [a,c] The second change is a clarification to remove implication that **[**

] [a,c] The third change is editorial.

a,c

(eq. 1)

Attachment 3

Affidavit of Shawn Gibby

AFFIDAVIT of Shawn Gibby

1. I am Vice President of Nuclear Engineering, Duke Energy Corporation, and as such have the responsibility of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear plant licensing and am authorized to apply for its withholding on behalf of Duke Energy.

2. I am making this affidavit in conformance with the provisions of 10 CFR 2.390 of the regulations of the Nuclear Regulatory Commission (NRC) and in conjunction with Duke Energy's application for withholding which accompanies this affidavit.

3. I have knowledge of the criteria used by Duke Energy in designating information as proprietary or confidential. I am familiar with the Duke Energy information contained in Enclosure 1 and Attachment 1 of Duke Energy letter RA-22-0102, response to request for additional information regarding request to approve DPC-NE-1007-P, Revision 1.

4. Pursuant to the provisions of paragraph (b)(4) of 10 CFR 2.390, the following is furnished for consideration by the NRC in determining whether the information sought to be withheld from public disclosure should be withheld.

    (i) The information sought to be withheld from public disclosure is owned by Duke Energy and has been held in confidence by Duke Energy and its consultants.

    (ii) The information is of a type that would customarily be held in confidence by Duke Energy. Information is held in confidence if it falls in one or more of the following categories.

        (a) The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by a vendor or consultant, without a license from Duke Energy, would constitute a competitive economic advantage to that vendor or consultant.

        (b) The information requested to be withheld consist of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage for example by requiring the vendor or consultant to perform test measurements, and process and analyze the measured test data.

        (c) Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation assurance of quality or licensing of a similar product.

        (d) The information requested to be withheld reveals cost or price information, production capacities, budget levels or commercial strategies of Duke Energy or its customers or suppliers.

        (e) The information requested to be withheld reveals aspects of the Duke Energy funded (either wholly or as part of a consortium) development plans or programs of commercial value to Duke Energy.

(f) The information requested to be withheld consists of patentable ideas.

The information in Enclosure 1 and Attachment 1 of Duke Energy letter RA-22-0102 is held in confidence for the reasons set forth in paragraphs 4(ii)(a) or 4(ii)(c) above. The category for all proprietary information is identified next to the right proprietary bracket. Rationale for holding this information in confidence is that public disclosure of this information would provide a competitive advantage if the information was used by vendors or consultants without a license from Duke Energy. Public disclosure of this information would diminish the information's marketability, and its use by a vendor or consultant would reduce their expenses to duplicate similar information. The information consists of analysis methodology details, analysis results, supporting data, and aspects of development programs, relative to a method of analysis that provides a competitive advantage to Duke Energy.

(iii) The information was transmitted to the NRC in confidence and under the provisions of 10 CFR 2.390, it is to be received in confidence by the NRC.

(iv) The information sought to be protected is not available in public to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld is that which is marked in Enclosure 1 and Attachment 1 of Duke Energy letter RA-22-0102, response to request for additional information regarding request to approve DPC-NE-1007-P, Revision 1. This information enables Duke Energy to:

(a) Support license amendment requests and reload calculations for its Catawba and McGuire reactors.

(b) Conditionally Exempt the EOC MTC Measurement required by Technical Specification Surveillance Requirement 3.1.3.2.

(vi) The proprietary information sought to be withheld from public disclosure has substantial commercial value to Duke Energy.

(a) Duke Energy uses this information to reduce vendor and consultant expenses associated with supporting the operation and licensing of nuclear power plants.

(b) Duke Energy can sell the information to nuclear utilities, vendors, and consultants for the purpose of supporting the operation and licensing of nuclear power plants.

(c) The subject information could only be duplicated by competitors at similar expense to that incurred by Duke Energy.

5. Public disclosure of this information is likely to cause harm to Duke Energy because it would allow competitors in the nuclear industry to benefit from the results of a significant development program without requiring a commensurate expense or allowing Duke Energy to recoup a portion of its expenditures or benefit from the sale of the information.

Shawn Gibby affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on April 7, 2022.

Shawn Gibby